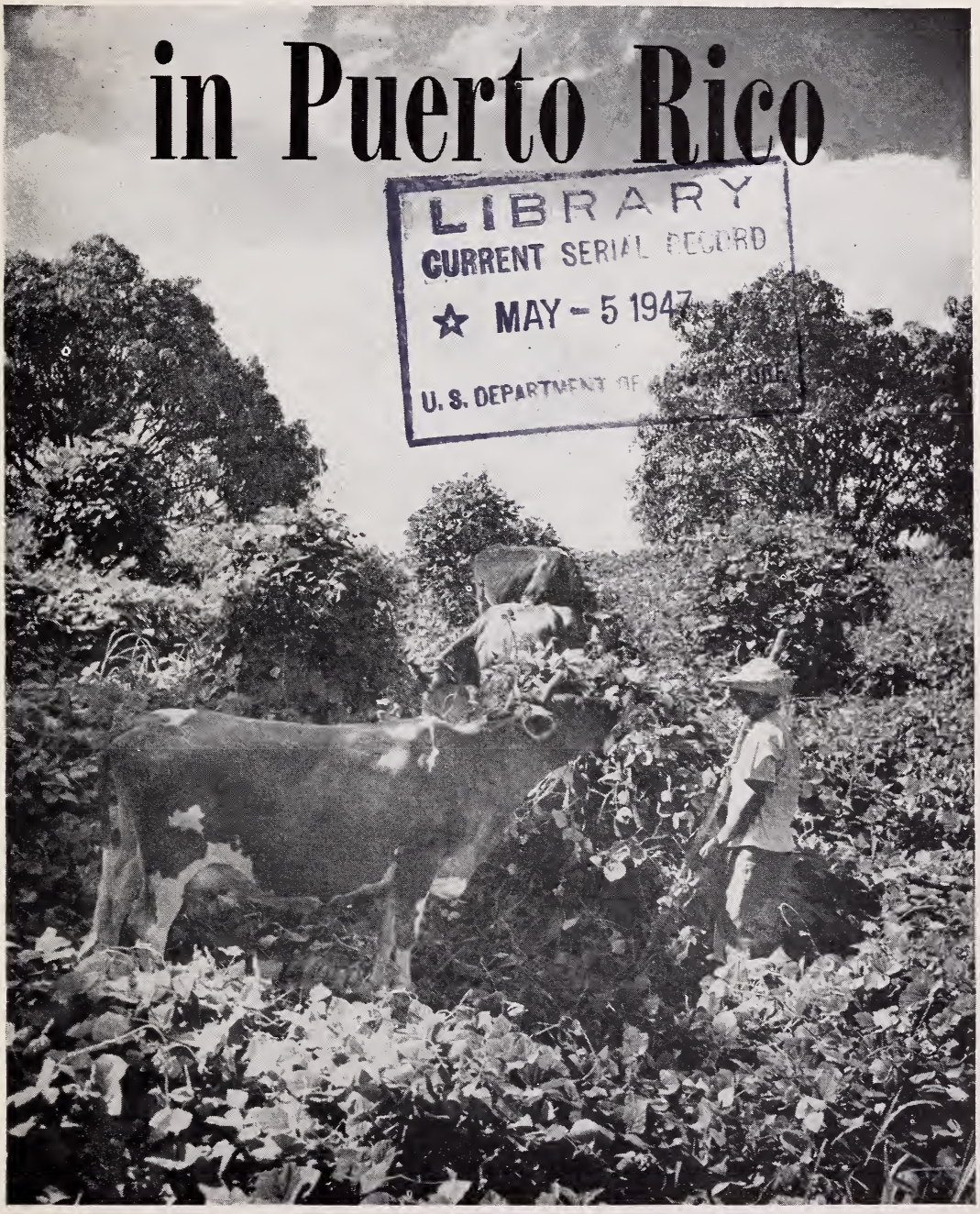
TROPICAL KUDZU in Puerto Rico



CIRCULAR NO. 27

Federal Experiment Station in Puerto Rico

UNITED STATES DEPARTMENT OF AGRICULTURE

Office of Experiment Stations

FEDERAL EXPERIMENT STATION IN PUERTO RICO
MAYAGUEZ, PUERTO RICO

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COVER ILLUSTRATION.—Tropical kudzu is a vigorous, deep-rooted leguminous vine, which is relatively resistant to drought and when well established can be depended upon to supply forage for livestock during the dry season. Other valuable features of tropical kudzu are described in this circular.

[1] In cooperation with the Government of Puerto Rico.

FEDERAL EXPERIMENT STATION IN PUERTO RICO
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TROPICAL KUDZU IN PUERTO RICO

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CONTENTS

INTRODUCTION

There has been a long-time need in Puerto Rico for a vigorous legume similar to the kudzu (*Pueraria thunbergiana* (Sieb. and Zucc.) Benth.) which is widely planted in the southern United States for soil erosion control and as a pasture and hay crop. The island has thousands of acres of inland unproductive hillsides, erosion gullies, and relatively poor pasture areas which could be profitably planted to such a crop. Unfortunately, *P. thunbergiana* has not grown satisfactorily under tropical conditions in Puerto Rico. The plants make fair growth for a few months, then become more or less dormant; also, the hairless leaves are highly susceptible to attack by the velvetbean catepillar (*Anticarsia gemmatilis* (Hbn.)). A similar unsatisfactory response of *P. thunbergiana* is reported in Hawaii, where it has been tested from sea level to 4,000 feet elevation (*13*).[2]

In 1940 the Soil Conservation Service of the United States Department of Agriculture in Puerto Rico introduced seed of another species of *Pueraria* known as *P. phaseoloides* (Roxb.) Benth. (*P. javanica* Benth.)[3] which has been locally named "tropical kudzu." Under

[1] The authors sincerely appreciate the constructive contributions made by the following: Kenneth A. Bartlett, director of the Federal Experiment Station; R. Y. Bailey, senior conservationist, Spartanburg, S. C.: R. N. Jobe, associate conservationist, Mayaguez, P. R.; and U. S. Allison, director, Soil Conservation Service, San Juan, P. R.

[2] Italic numbers in parentheses refer to Literature Cited, p. 28.

[3] Seed brought to Puerto Rico by Dr. W. F. Stewart, Boyce Thompson Institute, Yonkers, N. Y., from Rubber Research Institute of Malaya, Kuala Lumpur, Selangor, Federated Malay States.

Puerto Rican conditions tropical kudzu exhibits most of the outstanding qualities of its close relative in the southern United States and, in some respects, it is superior in that it seeds heavily, is readily established from seed, and grows 12 months of the year. With regular rains it thoroughly covers the ground in the comparatively short time of 6 months. On bare land, its dense foliage assists in reducing soil erosion caused by beating raindrops (fig. 1) which is common on

FIGURE 1.—The heavy beating of tropical raindrops on bare soil is an important erosion factor in Puerto Rico. Note protection given by dead leaves perched on columns of soil. Note, also, invading runners of tropical kudzu, which will anchor the soil within another 2 months.

barren land in regions of heavy and frequent tropical downpours. The dense cover also catches and holds considerable rainfall which is absorbed by the soil. Tropical kudzu has several other qualities: It is relatively resistant to drought, grows well in full sun and beneath moderate shade (fig. 2, *A*), has no serious insects or diseases, and makes good pasture or hay for dairy cows. (See cover photo.) The legume tends to spread from an original planting when seeding is permitted, but there is no evidence that it will become a pest.

The trailing runners of tropical kudzu may extend 20 feet or more up and down banks, under trees, and over grasses, bushes, and weeds until most of the undergrowth is smothered. It competes successfully with such forbs and grasses as nutgrass (*Cyperus rotundus* L.), carpet grass (*Axonopus compressus* (Swartz) Beauv.), guinea grass (*Panicum maximum* Jacq.), molasses grass (*Melinis minutiflora* Beauv.), and Pará grass, or malojillo (*P. purpurascens* Raddi). It covers the ground more thoroughly and quickly under pasture trees than some grasses, such as molasses grass (see fig. 3). When planted among trees, it has a tendency to climb upon the limbs and trunks (fig. 2, *A*), but the runners can be removed at 1- to 3-month intervals and the labor involved is considerably less than that required to cut with a machete the natural growth of the entire area. McIndoe [4] recommends removing a 3- to 5-foot diameter ring of *Pueraria* growth from around the base of each tree. It is especially important that the runners of tropical kudzu be removed from young trees at regular intervals to prevent breaking of limbs or felling the entire tree. With older trees frequent cutting is not so important.

One of its primary uses in the Far East is for ground cover to prevent soil erosion and loss of fertility after clearing jungle for rubber and cinchona plantations. The Firestone Plantations Co., in Liberia, West Africa, has used *Pueraria phaseoloides* since 1929, and recently reported over 30,000 acres planted among young and maturing rubber trees. Heilman [5] of that company states that, ". . . among numerous cover crops tried in Liberia, this particular one dries out the least during several months of drought and, consequently, does not present a serious fire hazard. Some disastrous fire experience has been encountered with *Calopogonium mucunoides* Desv."

McIndoe,[6] of the Firestone Co., states that the thick mat of *Pueraria* apparently will persist indefinitely in open areas. In the rubber plantations when the trees reach 5 years of age, however, the green mat begins to thin out, and in dense unthinned rubber plantings the *Pueraria* may disappear entirely. This is especially true on some soils. On the most fertile soils, however, the *Pueraria* may persist very well even under the shade of old rubbertrees both in Liberia and Sumatra. He has not been successful in establishing the crop under already existing shade. Soils in Liberia are of a red gravelly lateritic type, definitely acid in reaction. The plant thrives equally well on the fertile lowland and rocky, less fertile upland soils.

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[4] McIndoe, K. G. In correspondence from Firestone Plantations Co., Monrovia, Liberia, West Africa. 1945.

[5] Heilman, H. W. In correspondence from Firestone Plantations Co., Akron, Ohio. 1945.

[6] See footnote 4, above.

FIGURE 2.—*A*, A heavy crop of tropical kudzu growing under the moderate shade of a mango tree. This crop makes a good ground cover between economic tree plantations, but the runners must be removed from the young trees at regular intervals to prevent them from breaking limbs. *B*, Tropical kudzu growing on so-called unproductive Nipe clay near Maricao, P. R.

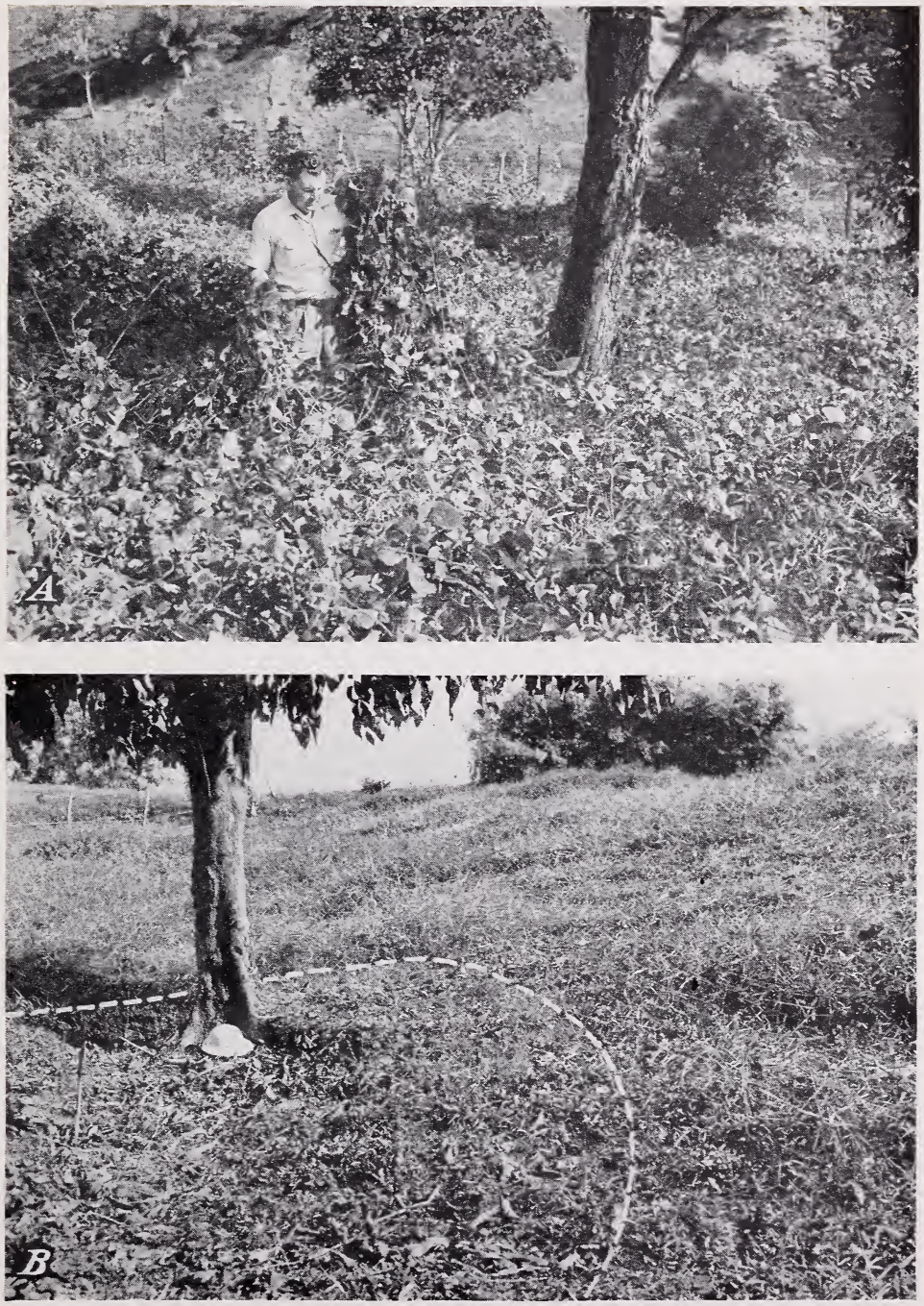

FIGURE 3.—Six months after planting tropical kudzu (*A*) and molasses grass (*B*) the kudzu had completely covered the ground beneath a tree, whereas the molasses grass in a neighboring plot had grown only to the perimeter of the tree, as shown by the dash line. The long runners of tropical kudzu enable it to thrive beneath trees in spite of the latter's competition.

Ashplant (*1*) and McIndoe report better growth of rubbertrees with a cover crop of *Pueraria*. Ashplant reports a definite reduction in death of rubbertrees from Fomes root rot when a cover of *Pueraria* is employed in Sumatra.

A recent report by Schofield (*15*) from northern Australia shows the superior value of *Pueraria phaseoloides* as compared with fallow soil and three other popular tropical legumes, namely, *Centrosema pubescens* Benth. (centro), *Calopogonium mucunoides* Desv. (calopo), and *Stylosanthes guianensis* Sw. (stylo). The climatic conditions under which Schofield's experiments were performed appear to be similar to those in Puerto Rico. He summarizes his work and general experience with *P. phaseoloides* (puero) under the conditions of northern Australia as follows:

> Under conditions in the "wet tropics," puero—which is closely related to Kudzu and is in fact its tropical counterpart—has proved to be a legume of outstanding value. It is used extensively in Malaya and Sumatra as a plantation cover crop to assist in maintaining soil fertility and in the prevention or control of erosion, and its ability to withstand light shade has extended its usefulness considerably. The results obtained in this experiement (fig. 4)) demonstrate that large quantities of nitrate nitrogen are produced rapidly during its de-

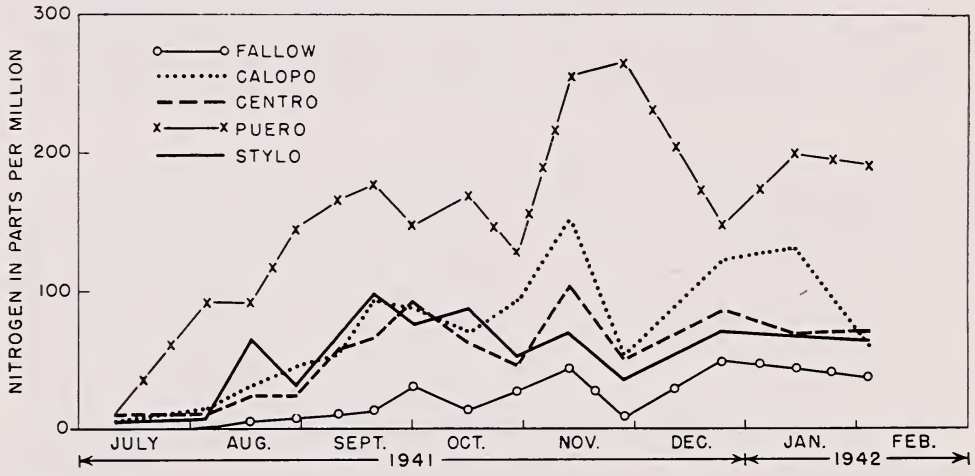

FIGURE 4.—Nitrate in the 6- to 12-inch layer of soil 6 days after above legumes were plowed under in northern Australia. Legumes were established from seed and grown for 18 months; all results were highly significant. Note superior value of puero, *Pueraria phaseoloides*. (After Schofield (*15*, *p. 187*).)

composition after ploughing under a crop grown for 18 months; and this is quite apart from its value as a source of humus, which would not be inconsiderable.

Puero is easy to establish from seed or cuttings, and it is so aggressive that it has been used successfully as a weed-smother crop. Puero roots freely at the nodes under suitable conditions and forms a carpet 2 feet deep, completely covering the soil, shading it from the sun, preventing the direct impact of rain, and ensuring adequate protection against soil erosion. It is a rather shy seed-bearer, and thus little trouble from self-regeneration occurs when an area of the crop is ploughed and the land placed under cultivation. The beneficial effect on soil structure of the organic residues from the various legumes, especially puero, is a further factor of the utmost importance. . . .

Puero is palatable and may be of special value as a pioneer legume in the rehabilitation of rain-forest areas which have been opened and planted to grass, but where the topography precludes ploughing as a means of overcoming weed-infestation prior to replanting. It may in addition be used with advantage on areas where ploughing can be undertaken, but where the soil is low in nitrogen

and humus and weeds have taken possession; that is on worked-out, washed-out, "dead" soils. Experimental work has indicated that the planting of single- or double-furrow strips, 10 to 15 feet apart on the contour, may be sufficient to allow puero to become established and smother out the weeds.

WHY A LEGUME?

The use of legumes in rotation has long been recognized as the soundest and most economical method of raising and maintaining the productivity of the soil (*8*). This is chiefly because legumes have the ability to accummulate nitrogen from the air through nodule-forming bacteria in the roots. Some leguminous plants are able to grow on eroded areas too poor to support other plant growth and, ultimately, they raise the nitrogen and organic matter content of the soil to a level at which pasture grasses will grow.

Legumes often will stimulate the growth of grasses in a mixed pasture (*6*). This has been noted at Río Piedras, P. R., where better growth of Pará grass was obtained when grown in combination with tropical kudzu. Some legumes, including tropical kudzu, make growth during seasons when grasses are less vigorous, as, for example, during the winter season in Puerto Rico, and, therefore, make good mixtures with grasses. For feeding, legumes are of exceptional value because they are rich in calcium, protein, and certain vitamins (15). They make up for constituents frequently deficient in grasses.

Generally speaking, legumes are more difficult than grasses to establish and maintain in a pasture. This is mainly because the growing buds of legumes are eaten off by the grazing livestock, whereas buds of grasses are enclosed and are level with or slightly beneath the soil surface. It should be emphasized, however, that the inclusion of legumes in a pasture mixture is a basic feature of sound grazing husbandry in the Temperate Zone, and it has been found that livestock forage consisting of a legume-grass mixture is more economical and profitable than a forage of grasses alone. In Puerto Rico there is a definite need among dairymen for a high-protein legume for forage. Protein concentrates are shipped into the island in large quantities, and they constitute the most expensive part of the ration.

HISTORY AND BOTANY OF PUERARIA PHASEOLOIDES

Pueraria phaseoloides appears to be relatively little known in the Western Hemisphere, but it has been grown for many years in the Far East—in Malaya, Sumatra, Ceylon, Java, South China, and neighboring countries. Its origin is not definitely known, although Bunting and Milsum (*7, pp. 270–271*) and state that it is indigenous to Malaya. The literature contains at least one reference and description dating back to 1867 (*5, p. 125*). In the Far East there are many local common names for this plant, but apparently the research workers have been content with calling it "*Pueraria*," *Pueraria javanica*, or *P. phaseoloides*, of which the latter is preferred.

Tropical kudzu is a vigorous, leguminous vine which has soybean-like leaves (fig. 5). The numerous above-ground stolons intertwine and cling tenaciously to the soil by taking root at the nodes and internodes (fig. 6, *B*), which make it an ideal soil erosion control crop. It

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has a deep and widely branching root system as shown in figure 6, *A*.

Herbarium specimens of tropical kudzu were sent to the Division of Plant Exploration and Introduction, United States Department of Agriculture, from which the following botanical description [8] was derived:

Pueraria phaseoloides (Roxb.) Benth. (Fabaceae)

A twining vine, clothed with dense spreading brown hairs; leaves trifoliolate; stipules small, lanceolate, basifixed; leaflets membranous, green, and thinly clothed with appressed hairs above, gray and more or less densely matted beneath, the terminal leaflet very variable in size and shape, usually broadly ovate to rhomboidal, entire or rarely somewhat 3-lobed, 6–15 centimeters long; flowers in long-peduncled racemes; pedicels 3–8 millimeters long; bracteoles lanceolate, 2–3 millimeters long, strongly nerved, strigose and hirsute; calyx 5 millimeters

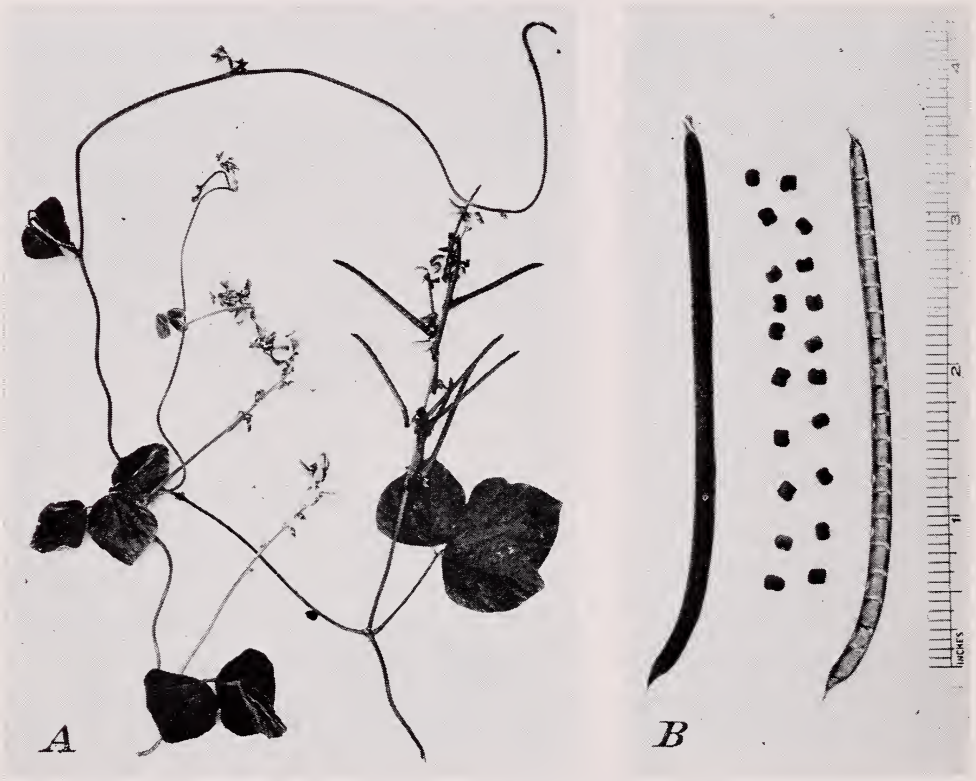

FIGURE 5.—*A*, Tropical kudzu (*Pueraria phaseoloides* (Roxb.) (Benth.) is a vigorous perennial stoloniferous legume which can be used for pasture or cover crop or in controlling soil erosion. It fruits heavily from December to February. The flowers are lavender with white fringes, and the leaves resemble soybean leaves. *B*, The laminated pods are black with dark-brown to yellowish seeds.

long, strigose and bristly hirsute, the teeth 1.5–2 millimeters long, broadly oblong and abruptly acute except the lowermost which is lanceolate with setaceous tip; corolla deep to light lavender, often with whitish fringes, 15 millimeters long; blade of standard roundish, distinctly spurred; pod 6–10 centimeters long, 4 millimeters wide, black when ripe, trigose, rather turgid, 15–20 seeded.

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[8] The authors appreciate the assistance of F. J. Hermann, associate botanist, Division of Plant Exploration and Introduction, U. S. Department of Agriculture, for aid in identification and preparation of a botanical description of *Pueraria phaseoloides*.

Until 1945, 17 introductions of *Pueraria phaseoloides* had been made into the United States, and from table 1 it is apparent that these introductions came from widely separated tropical countries, including three in Latin America.

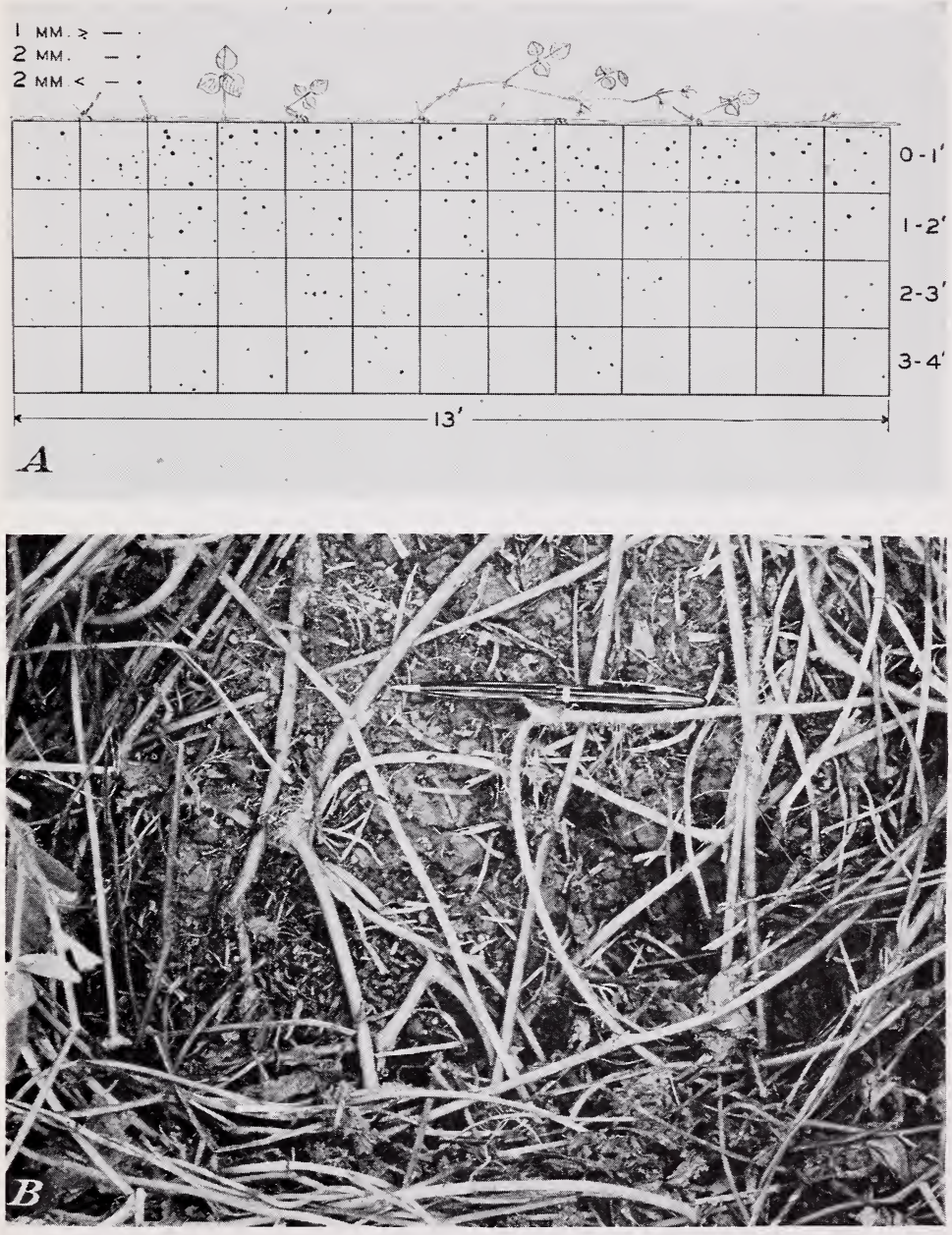

FIGURE 6.—*A*, A ditch was dug 4 feet deep and 13 feet wide to study root distribution of 2-year tropical kudzu. Although most of the roots were in the upper foot of this heavy Catalina clay soil, it is apparent that several large roots had penetrated to a depth of 4 feet or more. *B*, On the soil surface near the ditch shown in *A*, vegetation was pulled back to show the thick mat of tropical kudzu rooted to the soil. Note root nodules above the pencil point.

TABLE 1.—*Introductions of Pueraria phaseoloides into the United States by the Division of Plant Exploration and Introduction, United States Department of Agriculture*

Plant introduction No.	Source	Received
27491	Darjeeling, India	1910
30964	Lamao, P. I.	1911
47850	Darjeeling, India	1919
66256	Kandy, Ceylon, India	1926
102775	Darjeeling, India	1933
130946	Costa Rica	1938
132998	Sumatra, East Indies	1939
133961		
133962	Island of Réunion	1939
136644	Mindanao, P. I.	1940
137643	Netherlands East Indies	1940
143802	Java	1942
145021	Brazil	1942
148446	Colombia	1944
148883	Belgian Congo	1944
148993	Liberia	1944
150702	Nigeria	1945

CLIMATIC REQUIREMENTS

Pueraria phaseoloides grows and seeds best in Puerto Rico where minimum rainfall is not less than about 50 inches a year. At Mayaguez, it grows luxuriantly under average annual rainfall conditions of 81.5 inches, with a winter dry season of about 3 to 4 months' duration beginning in November. Tropical kudzu has been grown successfully from about sea level at Mayaguez to 3,200 feet in the Toro Negro Mountains, where winter night temperatures on some occasions fall to 50° F. The growth is somewhat slower and more stocky at Toro Negro than at Mayaguez especially during the winter season, as a result of the approximately 5° F. lower mean temperature. In Liberia 2 years after planting among rubber trees, it makes dense growth about 2 feet deep. Annual rainfall in Liberia averages about 130 inches, with a dry season extending from November to February. Under climatic conditions in British Guiana favorable results have been reported recently by Williams[9] in preliminary trials.

Results with tropical kudzu in a temperate climate have been unsatisfactory. According to Scott,[10] *P. phaseoloides* has been grown at Thorsby, Ala., Coffeeville, Miss., and Chapel Hill, N. C., where the growth was vigorous, but the plants were killed by frost. It is probable that tropical kudzu would grow successfully in frost-free areas of the southern United States.

SOIL REQUIREMENTS

Tropical kudzu does not appear to be exacting in soil requirements. At the station, it grows satisfactorily on heavy clay subsoil

[9] WILLIAMS, H. B. In correspondence from the Department of Agriculture of British Guiana. 1945.

[10] SCOTT, L. B. In correspondence from the United States Soil Conservation Service, Spartanburg, S. C. Oct. 1945.

with an approximate acidity of pH 5.0 (fig. 7). In a stiff Catalina clay soil (pH 4.5), the roots of a 2-year plant were found to penetrate vertically with little difficulty to a depth greater than 4½ feet, as shown in figure 8. No doubt this accounts for its ability to con-

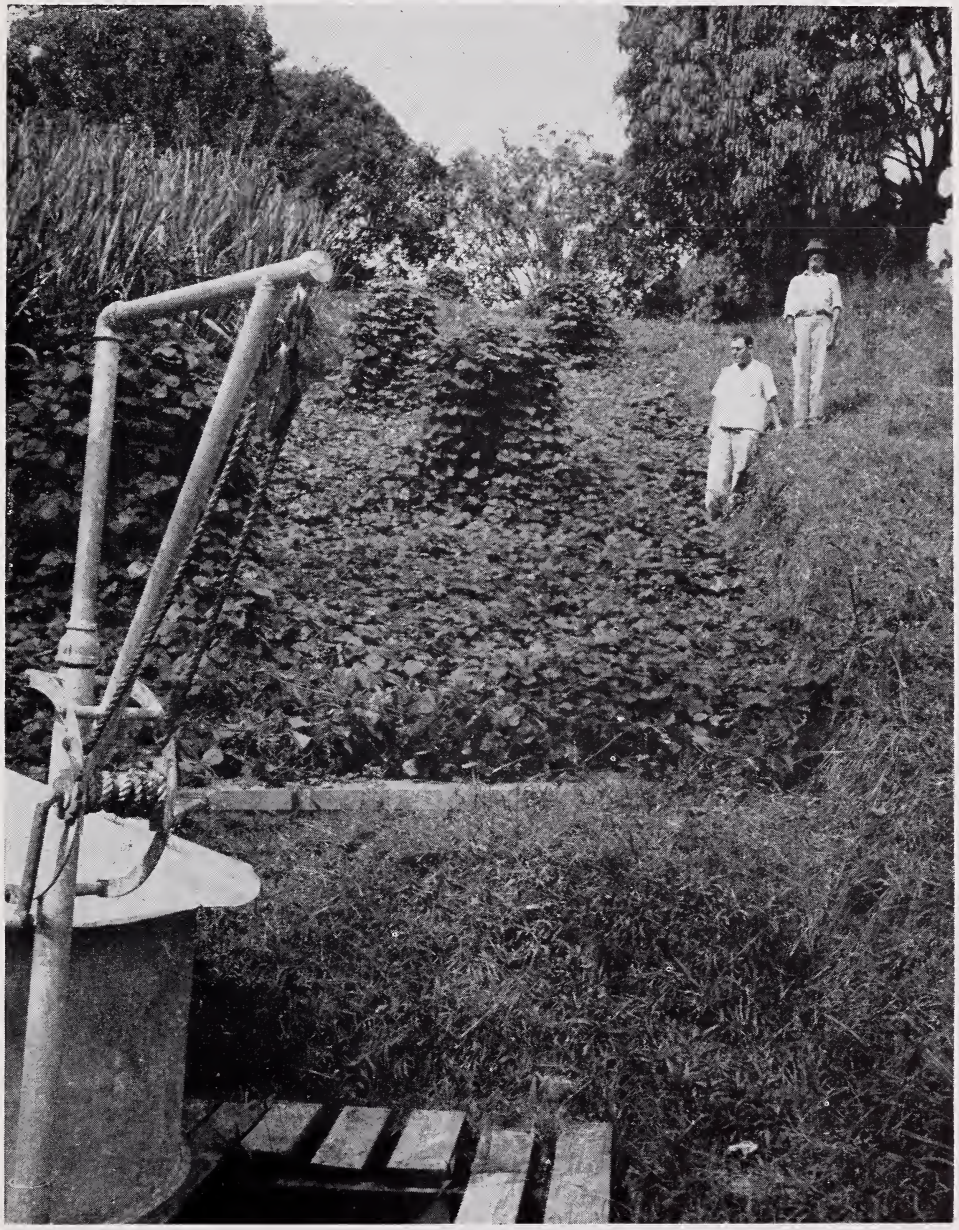

FIGURE 7.—The upper 2 feet of surface soil on this 40-percent slope was removed 6 years previously and maintained under clean cultivation until tropical kudzu was planted in March 1945. By planting kudzu the soil-erosion loss from this plot was reduced from an average of 2,300 pounds per acre per inch of rainfall to about 50 pounds in September 1945. Above photo was taken in November. Amount and intensity of rainfall was about the same for these two comparison periods. In June 1946 a 1.9-inch rain fell in 1 hour on the run-off plots. The kudzu cover absorbed 91 percent of the rain water whereas the nearby well-established sugarcane plots absorbed 16 percent less, or 75 percent.

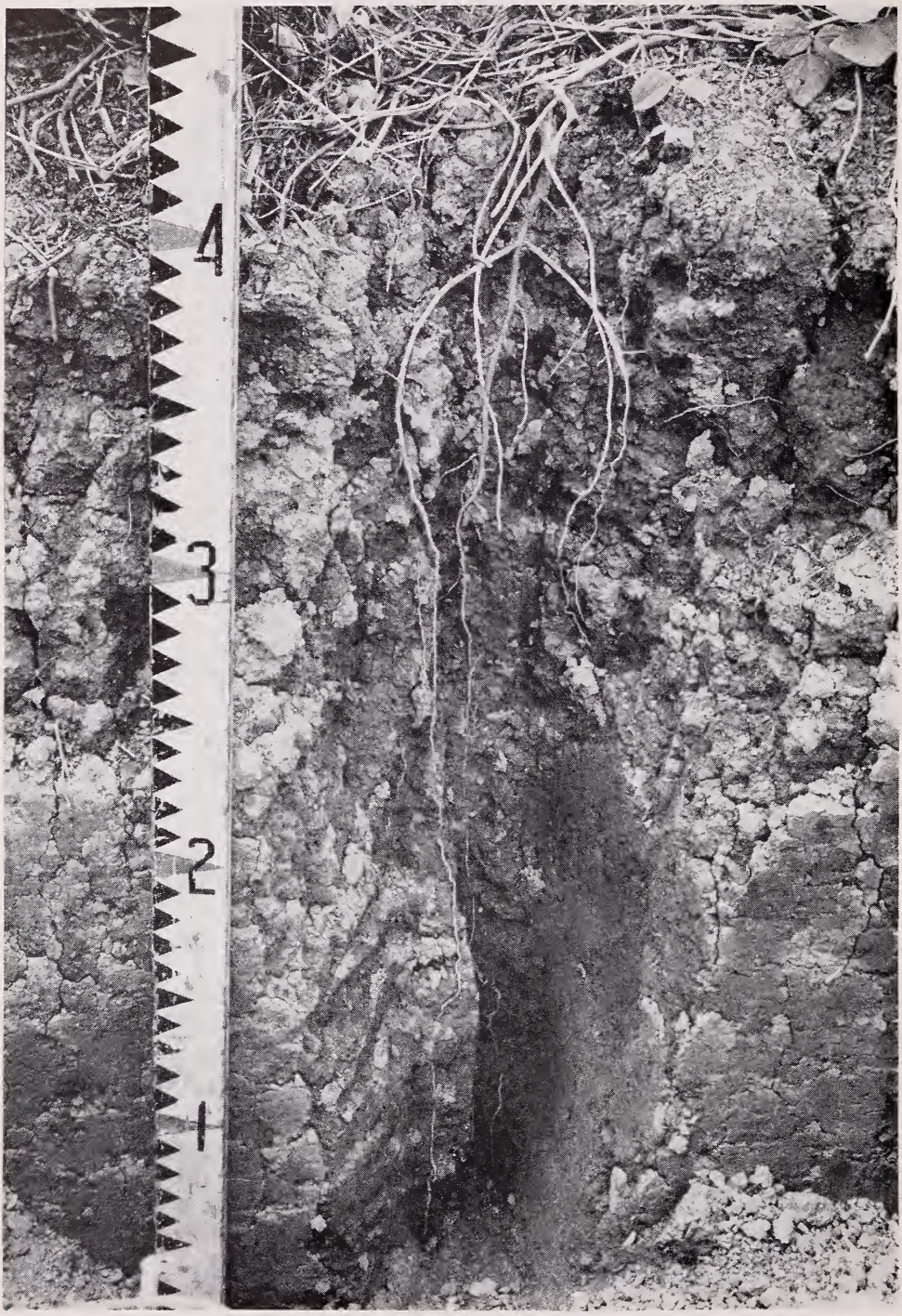

FIGURE 8.—In middry season, a planting of tropical kudzu was noted to be withstanding drought better than neighboring pasture crops. Vertical roots of this 2-year plant were traced to a depth of at least 4½ feet in the heavy clay soil.

tinue growing slowly during extended dry periods when other legumes, such as trailing indigo (*Indigofera endecaphylla* Jacq.), show considerable distress.

Good crops of tropical kudzu also have been grown on sandy loams used in road fills near Añasco and Guajataca, P. R. On Las Mesas and near Maricao (fig. 2, *B*), the crop is making good growth on Nipe clay of pH 4.6–5.1, which is considered by Roberts (*14, p. 200*) to be low in lime and phosphorus and, in fact, the most unproductive soil in Puerto Rico. Applications of a complete fertilizer, 10–10–5, were used in most of the above cases to obtain a stand of tropical kudzu.

At Mayaguez, the crop has withstood excess soil moisture conditions, where water stood in spotted areas on the soil surface for a week or more after the frequent and heavy summer rains. Where there is a heavy stand of tropical kudzu on such areas, the long runners are usually anchored here and there on drier areas, from which most of the nutrients are probably derived during periods of excess soil moisture. In Liberia, McIndoe [11] reports that the plant thrives on low, recently drained swamps where the water table is 6 to 12 inches below the surface.

On fertile lowland soil in Puerto Rico, as in Liberia [11] the experience has been that weeds tend to give the *Pueraria* seedlings stiff competition and more frequent weedings are usually necessary to obtain a kudzu cover. It has been shown at Mayaguez, however, that once tropical kudzu is established on fertile lowland, it competes successfully with other vegetation, and excellent yields of kudzu can be obtained.

PLANTING METHODS AND PREPARATION OF SEEDBED

On upland rolling and hilly soil or on undulating more or less bare land, tropical kudzu should be planted in strips or hills in order to prevent soil erosion while the plants are becoming established. Strips can be plowed on the contour (fig. 9) and spaced from 15 to 25 feet apart, center to center, depending upon the seed and labor available, steepness of the slope, and the rapidity with which a complete ground cover is desired. The uncultivated native strips of grass between the cultivated areas will assist in controlling erosion while the kudzu is taking over.

Kudzu planted in hills 6 feet apart in plowed strips spaced 20 feet apart requires, with proper management, approximately a year to cover the ground completely. With this spacing, two or more weedings will be necessary in the seedbeds to control the tall-growing weeds and bushes. As the kudzu runners reach the outer borders of the cultivated strips, two or three additional furrows are plowed toward the vines at about monthly intervals until eventually the entire hillside has been plowed and become covered with kudzu. The plowing reduces weed competition and helps the runners take root.

The hill system of ground preparation and planting (no plowing) can be employed, but somewhat more hand labor is required. It is a convenient system where small areas of ground are to be planted and it is not worth while to use a plow. Patches of ground 3 feet in

[11] See footnote 4, p. 3.

diameter are spaded and prepared. The hills may be spaced, depending upon conditions, from 3 to 18 feet apart on the square. In young rubbertree plantations,[12] 2-foot diameter hills are placed in the center of the squares of trees which makes a spacing of about 18 feet, depending upon the planting distance of the young trees. Aside from a few initial weedings, no fertilization or additional cultivation attention is given. Under these conditions considerable runner growth is obtained in 12 months and a complete heavy cover within 18 to 24 months.

FIGURE 9.—On hilly land, tropical kudzu is best established by plowing strips 3 to 6 feet wide on the contour and planting the seed in hills. (See fig. 10.) The strips of native vegetation prevent erosion while the kudzu is taking over. As the kudzu runners reach the outer borders of the cultivated strips, two or three additional furrows are plowed toward the vines at about monthly intervals until eventually the entire hillside has been plowed and has become covered with kudzu. Plowing facilitates rooting of the runners.

In Puerto Rico best seedling growth has been obtained where the seedbed was plowed or spaded to a depth of 6 to 10 inches and harrowed and worked into a fine-textured bed. If the soil is low in fertility, fertilizer is worked into the upper 3 or 4 inches of soil as described in figure 10. A good cover of tropical kudzu was obtained at Mayaguez in 7 months on heavy excavated soil where shallow furrows about 3 feet apart were made on the contour into which the seed were dropped and left for the rain to cover with silt (fig. 11). There was no previous spading or cultivation of the seedbed. Growth of

[12] See footnote 4, p. 3.

FIGURE 10.—On the contour strips, shown in figure 9, slightly sunken areas are prepared with a mattock at 6-foot intervals. If the soil is low in fertility, one-eighth pound of 10–10–5 fertilizer is worked into the upper 3 to 4 inches of soil. A pinch of seed is sown on top of the soil and firmed with the foot.

the seedlings under these conditions was slow, however, especially where no complete fertilizer and lime were added (soil pH 5.2). It should be emphasized that tropical kudzu seedlings by nature grow slowly for the first 3 to 4 months (fig. 12) and they require special weeding and cultivation during this time to speed the growth as much as possible. Once they are well established at 5 months, however, growth is rapid. McIndoe[13] suggests mixing seed of *Calopo.*

[13] See footnote 4, p. 3.

gonium mucunoides with the *Pueraria* at planting, since the former grows more rapidly in the beginning and helps give an early covering while the more vigorous *Pueraria* eventually takes over.

Tropical kudzu is an excellent crop to cover shallow or deep eroded gullies (fig. 13, *B*), stop the moving soil, and thus gradually build up the gully floor. In the case of a large gully, 3-foot-wide strips of ground are prepared on either side of the gully at a distance of about 3 feet from the edge. With proper initial fertilization and weeding, the kudzu after 6 months should make rapid growth of runners which after 9 to 12 months may extend 20 feet or more into the gullied area. Such treatment of gullies not only controls erosion, but may turn formerly valueless land into productive forage areas for dairy cattle and other livestock, provided the character of the gullies is not dangerous to grazing livestock.

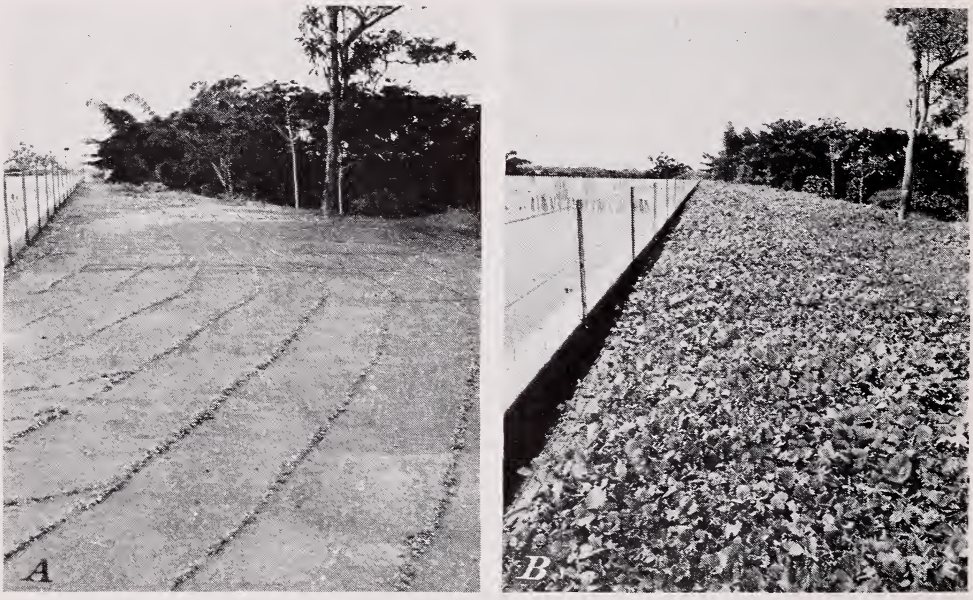

FIGURE 11.—*A*, Soil was excavated to a depth of 25 feet to build the station water-storage tank on the left. Tropical kudzu was planted on the subsoil on the contour in rows only 3 feet apart in order to arrest erosion quickly. *B*, This photograph shows coverage by tropical kudzu 7 months later. One weeding was necessary 5 months after planting to destroy tall-growing plants.

Where Pará grass or similar grasses are being grown on either bench or Nichols terraces, rows of tropical kudzu can be planted along the edge of each terrace to assist in holding the terrace and also intermingle with the grasses and increase the protein content of the combined cut forage.

If the slope of the land is gentle or almost level, a planting plan can be used in which four- to six-row strips of a grass such as Pará grass or molasses grass are planted in rows about 2 feet apart, and these strips alternated with a two-row strip of tropical kudzu planted in rows 3 feet apart. Both Pará grass and molasses grass are relatively low growing, and tropical kudzu readily intermingles with them. The kudzu will not smother the grasses if pastured or cut regularly (fig. 14.) It also can be grown similarly with elephant grass, guinea

grass, and Guatemala grass, but about four rows of tropical kudzu may be needed to successfully compete with these more vigorous grasses.

In regions of the island where field corn is grown, one row of tropical kudzu can be sown in every fourth to sixth row of corn. At Mayaguez, for example, the kudzu begins to take over about the time the corn is harvested and thence grows vigorously during the summer and early winter months, producing excellent pasture. The land can be left in kudzu for several years or pastured and plowed the following spring

FIGURE 12.—Seedlings of tropical kudzu grow slowly during the first 3 months, and it is important that they receive weeding and cultivation. The 4-month seeding at Toro Negro, 3,200 feet altitude, is beginning to send out runners.

FIGURE 13.—*A*, On infertile heavy clay soil tropical kudzu was readily established from seed planted in June (left), whereas trailing indigo planted with cuttings (right) was almost a complete failure. Photo taken 6 months after planting. *B*, Tropical kudzu planted in hills 3 feet from the edge near the head of a gully filled the gully in 6 months and stopped further erosion.

for another planting of corn. Ordinarily, there are enough stem and root cuttings of tropical kudzu from the first planting to gradually take over after the second corn crop has matured.

SEED TREATMENT AND GERMINATION

In relation to other tropical seed, *Pueraria phaseoloides* is exceptional in Puerto Rico in that its viability usually remains above 90-percent germination for at least 1 year under room temperature and humidity conditions. At Mayaguez, one batch of seed showed a germination of 68 percent after 3 years' storage in glass-stoppered jars under ordinary room conditions. Trials have indicated that seed over 6 months of age germinate more readily than seed less than 6 months of

FIGURE 14.—Tropical kudzu and Pará grass compete with each other favorably to produce a combined forage which is higher in protein than grasses alone. Tropical kudzu can be seen climbing elephant grass in the background.

age. There seems to be no serious insect pests or diseases of the seed in storage.

The seed coat is hard, and some kind of scarification is needed, especially on the older seed. Acid treatment is recommended for better germination and quicker emergence. The seed is cleaned and placed in a solution of equal parts of sulfuric acid and water [14] and stirred frequently during a period of about 30 minutes, then *washed thoroughly* with water and dried. It is best to plant immediately after treatment. Fair to good germination also has been obtained at this station by soaking the seed in water for 24 hours, inoculating, and

[14] The solution is prepared by mixing concentrated commercial sulfuric acid (H_2SO_4) with an equal volume of water. To mix, carefully *pour the acid into the water* and allow to cool before adding the seed.

planting immediately in moist soil. Most of the acid-treated or water-soaked seed will germinate within about 10 days, whereas untreated seed germinates over a period of 3 to 4 weeks and the germination percentage is usually considerably lower.

Another recommended method of scarification[15] is to rub the seed between two sheets of sandpaper. This requires more labor but less supervision. The same principle is employed by motor-driven mechanical seed scarifiers on the market, which are much quicker and more economical if large batches of seed are involved.

Sulfuric acid is poisonous and highly corrosive to skin and clothing. Great care should be taken in using the acid or the solution. Vessels should be thoroughly cleaned after using. The acid should not be stored on the premises.

With legumes it is generally recommended that the seed be innoculated with nodule-forming bacteria (see fig. 6, *B*) before planting. This is especially true where no legumes have recently grown on the soil. In Puerto Rico, Kinman (*10*) states that most of the soils contain nodule-forming bacteria because of the prevalence of many native legumes. However, if the land to be planted has been in a grass crop for several years with no legumes, it would be a wise precaution to treat the seed according to the manufacturers' recommendations on the container.[16] In fact, experience continues to show at this station that it is advisable to inoculate all seed immediately before planting.

Another system of inoculating seed is to haul surface soil from a field where tropical kudzu has recently grown. The soil is pulverized, and a few hundred pounds dusted on each acre of the field to be planted to kudzu. Or, a few pounds of the soil may be placed in a bucket of water and stirred. After the soil has settled to the bottom the water is poured into another bucket containing the seed. Nodule-forming bacteria in the water suspension adhere to the seed when it is removed.

TIME OF SEEDING

The preferred time for planting seed or cuttings of tropical kudzu in Puerto Rico is at the beginning of the rainy season, which is usually from April to May, although not always, as, for example, near the village of Lares, where the best time for planting falls in September or October. Rains assist the young plants in becoming established and making considerable growth before the dry season. Seed planted in June at Mayaguez has produced sufficient vegetative growth for grazing and for heavy flowering and seeding the following December to March.

Good stands of tropical kudzu have been obtained in 9 months near Guajataca (annual rainfall 50 inches) by planting the seed as late as September and October. However, the ensuing dry months limited the growth and it required 3 to 5 months' additional time to obtain a

[15] See footnote 4, p. 3.

[16] Special inoculant has been prepared for tropical kudzu by The Nitragin Co. Milwaukee, Wis. Inoculate the seed *after* scarification. Keep the bacteria away from strong light as much as possible.

good ground cover. If irrigation is available during the winter season, a good stand can be obtained in 6 to 8 months by watering to a depth of 6 inches at 1- to 2-week intervals during extended dry periods.

RATE OF SEEDING

The amount of seed required per acre will depend upon the quantity of seed and labor available and the rapidity with which a stand is desired. If the hills are spaced 3 feet apart, it requires about 5 pounds of seed per acre, using a pinch, or 10 to 12 seed, per hill. If hills are spaced 6 feet apart, the amount of seed required per acre will be about 2½ pounds. About 1 pound of seed per acre will be needed for hills spaced 18 feet apart.

METHOD OF SEEDING

Where seed is scarce or unavailable tropical kudzu can be propagated by 2-foot stem cuttings planted in 2-inch furrows on prepared ground (*7, pp. 270–271*). The cuttings should be spaced about 3 feet apart. In rainy weather the cuttings root readily and a 6- to 9-inch cover can be obtained in 3 to 4 months.

Seeding is used more than cuttings in Puerto Rico because the plants seed readily and heavily in many sections of the island. On the north side of the island where rainfall is relatively uniform, the seed can be sown on slightly sunken hills and covered with a *thin* film of soil to prevent them from being washed away. On the south side of the island in regions where conditions are relatively dry, it is preferable to cover the seed with about one-eighth inch of soil by pulling a small brush bundle over the bed. Germination is usually better and quicker if the soil is then tamped lightly with the foot or with a mattock. If there is danger of blackbirds and pigeons eating the seed, it is best to cover the seed with soil and perhaps a brush bundle.

FERTILIZERS

At planting time, the soil, if low in fertility, should be fertilized only in those areas where the seeds are to be planted. If the fertilizer is spread uniformly over the entire field, it not only wastes material but creates a greater weeding problem. A complete fertilizer such as 10–10–5 at the rate of about 400 to 600 pounds per acre, or about ⅛ pound per hill (hills 3 feet apart), is sufficient. For convenience in application, a tin can may be calibrated by placing ⅛ pound of fertilizer in the can and cutting the upper portion of the can off above the fertilizer level. The fertilizer should be thoroughly mixed with the upper 3 to 4 inches of soil (fig. 10); otherwise, the seedlings may be burned by the concentrated salts. Manure, if available, at the rate of 1 to 3 tons per acre mixed with the soil only in the areas of seeding is also effective in getting the seedlings off to a good start.

After the tropical kudzu has become established, the amount of fertilizer and frequency of application will depend upon the initial soil fertility and the amount of grazing. If the soil is reasonably fertile, fertilizer applications may be spaced at 2- or 3-year intervals or eliminated entirely. However, in case of the upland soils which are being grazed three or more times a year, it may be necessary to

apply superphosphate and potash once every 1 or 2 years. Superphosphate can be applied at the rate of 600 pounds per acre and muriate of potash at 150 pounds per acre. Nitrogen fertilizer is not needed after the planting has become established, since tropical kudzu is a legume and this element is furnished to the plant by the nitrogen-synthesizing bacteria in the root nodules.

In the Tropics, where there is an abundance of rainfall and where rapid leaching of nutrients is a problem, more frequent applications of fertilizer are necessary than in temperate regions. In the continental United States, for example, Bailey (4) suggests an application of 600 pounds of superphosphate and, where necessary, 100 pounds of muriate of potash per acre every third year in order to maintain production of kudzu on marginal and submarginal land.

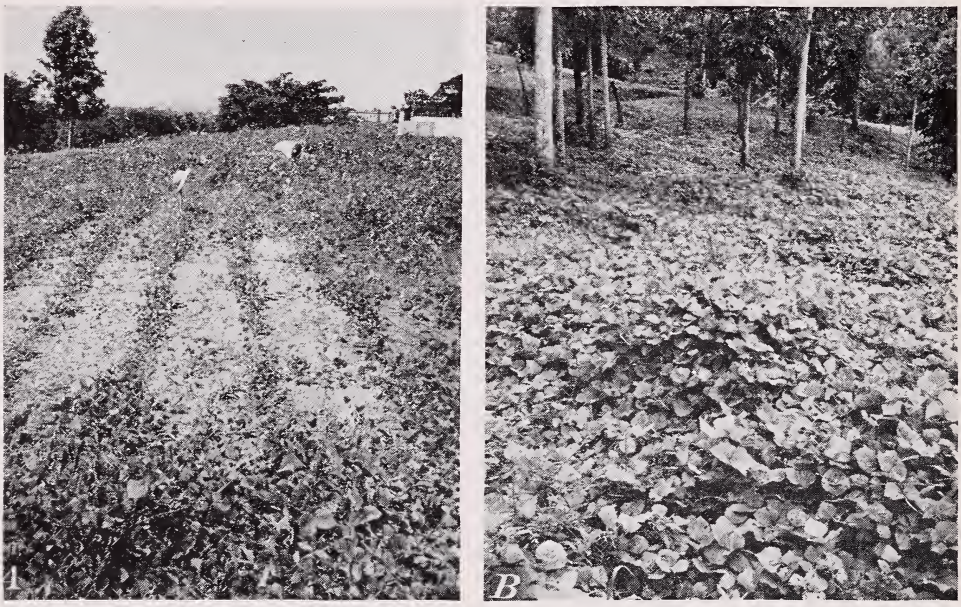

FIGURE 15.—A fertilizer experiment on excavated Catalina clay soil (*A*) revealed that lime alone (poor growth this side of hat) and muriate of potash (plot just beyond hat) had little effect on growth of kudzu seedlings, whereas complete fertilizer (background and immediate foreground) gave the seedlings a good start. Finely ground superphosphate was used on plot in (*B*) at the right. A complete fertilizer is recommended for seedlings, and if the soil pH is below 5.0, lime also should be applied.

About double this amount is recommended under tropical conditions, where, it should be pointed out, the plant is growing 12 months of the year, as compared with 7 to 9 months in the States. It has been emphasized by Blaser and associates (*6*) that applications of fertilizers to pastures definitely increase the nutritive value of the forage.

If there is some doubt as to the need of phosphorus or potash, test applications of these elements separately and combined can be made by the farmer on small areas 50 feet square. If a definite response in growth occurs after 4 to 6 months, it would be well to fertilize the entire area. There is some indication on Catalina soil, for example, that potash is needed only in small quantities, if at all, as shown in figure 15, *A*, whereas finely ground superphosphate (fig. 15, *B*) gave

definitely beneficial results, which is in agreement with Roberts (*14, p. 200*), who reports that Catalina soils are low in phosphorus. This is also in agreement with the results of Richardson (*12*) in Mississippi, where *Pueraria thunbergiana* gave the best response to applications of superphosphate.

The best time to fertilize established plantings of kudzu is immediately after the pasture has been cut or grazed to the point where the majority of the foliage has been removed. If the fertilizer is applied directly on the dense foliage of ungrazed tropical kudzu, it may cause severe burning of the foliage. If fertilization is necessary under such conditions, it can be spread by hand under the foliage in 2- to 3-foot strips spaced about 6 feet apart. Tropical kudzu becomes so intertwined over the entire area that all plants eventually get the benefit of such strip fertilization. It is unwise to fertilize during the dry season.

In conclusion, it should be stated that soils in general in Puerto Rico vary considerably in fertilizer requirements and in order to play safe in securing a quick, thrifty stand of tropical kudzu, it would be well to use a complete fertilizer at planting or about a month later. Later applications of phosphorus, lime, or potash can be determined by preliminary trials on a small scale.

PASTURING

During the grazing experiments at Mayaguez, the station's Guernsey cows developed a liking for tropical kudzu, especially during the dry season when plantings of elephant grass, guinea grass, Guatemala grass, and Pará grass and other common pasture crops did not produce sufficient forage. When the herd was first introduced to tropical kudzu in January 1945, several cows began eating immediately, while others ate a leaf here and there but preferred to graze on grass outside the kudzu plot. Within a day or two, however, all cows fed equally well.

It is estimated that about 1 acre of tropical kudzu will feed one cow grazing continuously during the dry season and two cows during the rainy season. Where pastures are grazed alternately by several cows, at least a 6-week interval should intervene between each grazing period. This gives ample time for the droppings to dissolve and a good cover of foliage to develop. In general, tropical kudzu should be grazed only once during the dry season, and it is recommended that the cows not be placed upon the kudzu until other pastures and forage have become definitely deficient, which is usually about the middle of the dry season. This reserves the green fresh kudzu for periods when pastures are beginning to show burning. Care should be taken that the kudzu is not grazed completely to the ground. Such grazing may cause a weak come-back. After some observations, the farmer can judge for himself the best grazing procedure with respect to his individual soil, climatic, and herd conditions.

Tropical kudzu has produced from 12 to 20 tons of green forage per acre per year at Mayaguez, depending upon soil fertility and weather conditions. An acre of this legume produces from two to four times as much forage of better quality as compared with the native volunteer pasture grasses. It has been grazed with success by work oxen and goats as well as milk cows, and probably is equally adapted

to other livestock such as poultry. When alfalfa became scarce in Mississippi during the war, Polk and Gieger (*11*) demonstrated that a 9-percent kudzu meal can be readily substituted for the commonly used alfalfa meal in chick rations.

Tropical kuzdu is relatively high in protein as compared with most forage crops, such as elephant grass, guinea grass, Pará grass, and similar grasses commonly fed to cows in Puerto Rico. Protein for a given weight of dry kudzu is from two to four times the amount found in the above grasses, as shown in table 2.

TABLE 2.—*Chemical analyses of tropical kudzu as compared with common pasture crops in Puerto Rico*

Constituent	Tropical kudzu [1]		Guinea grass (*Panicum maximum* Jacq.)[3]	Elephant grass (*Pennisetum purpureum* Schumach)[4]	Para grass (*Panicum purpurascens* Raddi.)[3]	Molasses grass (*Melinis minutiflora* Beauv.)[3]	Trailing indigo (*Indigofera endecaphylla* Jacq.)[5]
	Entire above-ground portion of plants [2]	Leaves and young stems only (April 1945)					
Ash [6]	5. 65	8. 00	8. 12	10. 40	7. 78	5. 99	9. 83
Proteins	15. 43	22. 78	4. 26	7. 50	7. 50	6. 38	19. 56
Ether extract	3. 54	4. 84	2. 57	3. 24	2. 37	3. 31	4. 33
Fiber	35. 52	28. 62	41. 74	32. 88	33. 52	37. 62	27. 24
Nitrogen-free extract	39. 86	35. 76	43. 31	45. 98	48. 83	46. 70	39. 04

[1] Analysis by Víctor L. Quiñones, assistant chemist, Insular Agricultural Experiment Station, Rio Piedras, P. R. Right column shows analyses based upon portions of vines largely utilized by grazing cows.

[2] Average of samples taken in January, May, and September; there was no marked effect of season on chemical analysis of tropical kudzu.

[3] Analyses taken from Axtmayer, Rivera Hernández, and Cook (*3*). (See table 3.)

[4] Axtmayer, Asenjo, and Cook (*2*). (See p. 119.)

[5] Analyzed by D. H. Cook, School of Tropical Medicine of the University of Puerto Rico, San Juan, P. R.

[6] The average percentage of moisture in green forage was about 75 percent; all figures are expressed on dry basis.

It is evident that a combination of tropical kudzu with a grass such as Pará grass is highly desirable in order to increase the protein content of the forage and reduce the need for supplemental commercial feeds which are relatively expensive. Trailing indigo, likewise, is high in protein, but this crop is somewhat more difficult to establish, produces about half the forage, and does not withstand drought as well as tropical kudzu (see fig. 16).

HARVEST OF SEED

Because of the scarcity of seed it may be impossible for farmers to secure more than one-fourth of a pound of seed at the outset.[17] This amount will plant about one-eighth of an acre for trial and seed production. The seed can be harvested from this initial plot and stored

[17] Contact your local county agricultural agent or soil conservationist regarding source of seed.

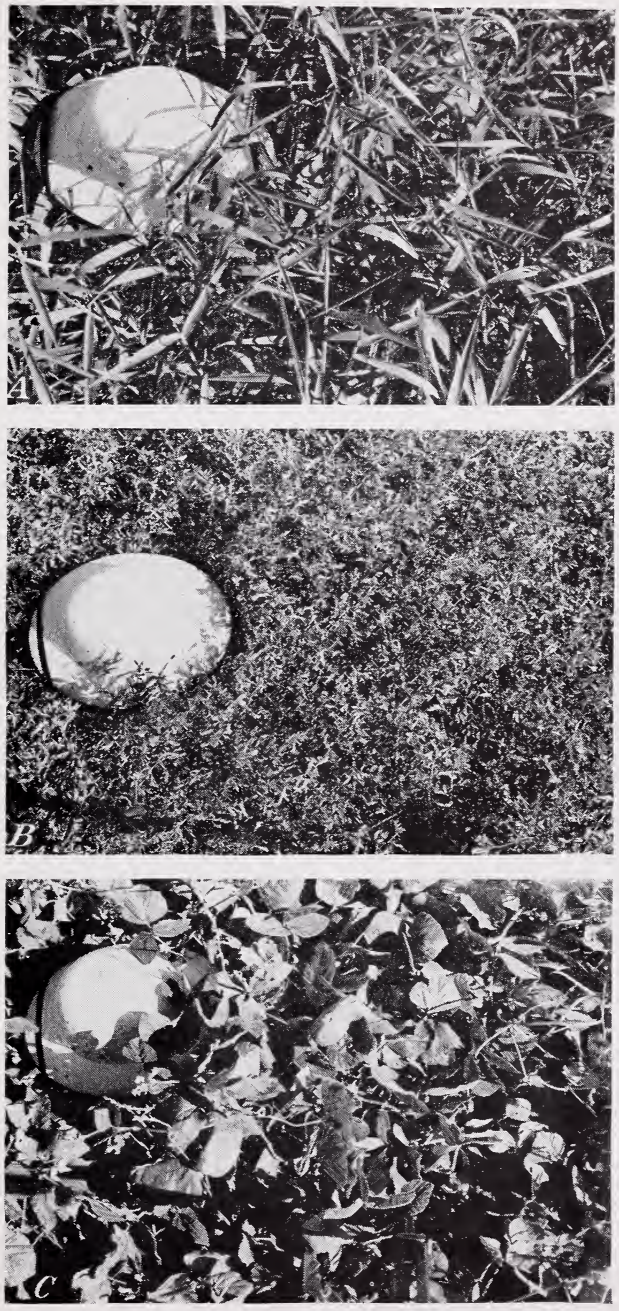

FIGURE 16.—Photographs show the amount of growth obtained with molasses grass (*A*), trailing indigo (*B*), and tropical kudzu (*C*) 6 months after planting. Two months later during a severe drought, the tropical kudzu was definitely superior to the other two crops in furnishing forage for dairy cows. The trailing indigo, in fact, showed considerable distress.

in jars under ordinary room temperature and humidity conditions until planting time.

Tropical kudzu flowers and seeds heavily at Mayaguez beginning in November and extending to the following March. It apparently fruits more heavily in regions where there is a definite dry period than in areas such as those in Malaya where rainfall is heavy and well distributed (*9, pp. 238–239*).[18] Seed and forage production can be increased per unit of ground by erecting tripods at 15- to 25-foot intervals (fig. 17), or by using living posts such as dwarf bucare (*Erythrina bertereana* Urban). It appears that mechanical harvesting may not be desirable because of the fact that the seed ripens over a period of 3 or 4 months. Insofar as is known, the seed is harvested entirely by hand (fig. 18), and it requires about 1 hour for one man to harvest a pound (36,000 seed per pound). One acre has produced

FIGURE 17.—Tropical kudzu seeds more heavily if staked. Note poor cover of *Pueraria thunbergiana* under tropical conditions in plot to left.

about 150 pounds of seed. It is necessary to go over the field systematically once or twice a week, picking only the black ripe pods. Five gallons of pods will yield about 2.7 pounds of seed. The harvested pods are laid in the sun, where they soon dry and break open.

[18] See footnote 4, p. 3.

The pods and seed are then placed in a sack or basket and beaten gently against the wall to knock the seed to the bottom of the container.

INSECTS AND DISEASES

During 5 years of experimentation with tropical kudzu at many different locations over the island, no serious diseases or insects have developed. Probably because of the pubescense of the foliage, little or no trouble has been encountered with the velvetbean caterpillar (*Anticarsia gemmatilis* (Hbn.)), which has been one of the limiting factors with the smooth-leaved *Pueraria thunbergiana*. From October to January, there is a leaf tier (*Hedylepta indicata* (F.)), which eats

FIGURE 18.—Seed is being harvested by hand in this heavily fruiting field of tropical kudzu; fruiting stalks are so thick that many of the leaves are obscured. One man can harvest about 1 pound of seed per hour.

holes in the leaves and rolls the margins, but this insect does not appear to be important.

The only disease encountered was an unidentified wilt which appeared in spotted areas over a 2-acre planting of tropical kudzu near Maricao on Nipe clay. The stems became soft brown and rotted as shown in figure 19, which resulted in patches of yellow and dead leaves. Runners from neighboring plants, however, were gradually covering these "blighted" areas. There is some indication that this may be due to low phosphorus in the soil.

Both the insect and disease noted above were considered to be of minor importance. The literature reviewed contains no reference to additional insect or disease troubles.

FIGURE 19.—An unidentified wilt in scattered patches near Maricao, P. R., was the only disease noted on tropical kudzu. The same disease was found attacking neighboring plots of trailing indigo, but the amount of injury in both instances was of minor importance. Runners turned from soft brown to black, and the leaves became yellow and died.

LITERATURE CITED

(1) ASHPLANT, H.
1940. THE REPLANTING OF OLD RUBBER AREAS, AND ROOT DISEASE. India Rubber Jour. 99: 342–344 (No. 14, pp. 8–10), illus.

(2) AXTMAYER, J. H., ASENJO, C. F., and COOK, D. H.
1938. THE NUTRITIVE VALUES OF SOME FORAGE CROPS OF PUERTO RICO. Puerto Rico Univ. Jour. Agr. 22: 119–121.

(3) ——— RIVERA HERNÁNDEZ, G., and COOK, D. H.
1940. CHEMICAL ANALYSES OF GRASSES. Puerto Rico Univ. Jour. Agr. 24: 32–34.

(4) Bailey, R. Y.
1943. kudzu conserves southern soils. Better Crops With Plant Food 27 (9) : 21–30, 48–49, illus.
(5) Bentham, G.
1867. notes on pueraria, dc., correctly referred by the author to phaseoleae. Linnean Soc. London, Jour. Bot. 9 : 121–125.
(6) Blaser, R. E., Stokes, W. E., Warner, J. D., and others.
1945. pastures for florida. Fla. Agr. Expt. Sta. Bul. 409, [78] pp., illus.
(7) Bunting, B., and Milsum, J. N.
1928. cover crops and green manures. Malayan Agr. Jour. 16 : 256–280, illus.
(8) Hosaka, E. Y., and Ripperton, J. C.
1944. legumes of the hawaiian ranges. Hawaii Agr. Expt. Sta. Bul. 93, 80 pp., illus.
(9) International Institute of Agriculture.
1936. use of leguminous plants in tropical countries as green manure, as cover and as shade. 262 pp., illus. Rome.
(10) Kinman, C. F.
1916. cover crops for porto rico. Porto Rico (Mayaguez) Agr. Expt. Sta. Bul. 19, 32 pp. illus.
(11) Polk, H. D., and Gieger, M.
1945. kudzu in the ration of growing chicks. Miss. Agr. Expt. Sta. Bul. 414, 14 pp., illus.
(12) Richardson, E. C.
1945. the effect of fertilizer on stand and yield of kudzu on depleted soils. Jour. Amer. Soc. Agron. 37 (9) : 763–770, illus.
(13) Ripperton, J. C.
1945. case for kudzu? Hawaii Farm and Home 8 (7) : 2, illus.
(14) Roberts, R. C., Thorp, J., Smith, L. R., and others.
1942. soil survey of puerto rico. U. S. Bur. Plant Indus., Soil Surv. Ser. 1936, No. 8, 503 pp., illus.
(15) Schofield, J. L.
1945. a comparison of soil nitrate nitrogen values under bare fallow and after ploughing in various perennial tropical legumes and cowpeas. Queensland Jour. Agr. Sci. 2 : 170–189, illus.

ADDITIONAL REFERENCES

(1) Baalen, J. van, and Heubel, G. A.
1938. de meest doelmatige grondbedekking in volwassen rubbertuinen. Bergcultures 12 : 585–597.
(2) Bailey, R. Y.
1944. kudzu for erosion control in the southeast. U. S. Dept. Agr. Farmers' Bul. 1840, 30 pp., illus.
(3) Basu, B. C.
1902. the cultivation of pulse crops in the assam valley. Assam Agr. Dept. Bul. 9 : 15 pp. (See pp. 14–15.)
(4) ———
1903. the cultivation of pulse crops in the assam valley. Agr. Ledger 10 : [125]–137. (See pp. 136–137.)
(5) Driessen, F. C.
1941. de beteekenis van de groenbemesting voor de overjarige cultures. Bergcultures 15 : 458–469.
(6) Federated Malay States Department Agriculture.
1934. cover crops. Fed. Malay States, Dept. Agr., Agr. Ser. Leaflet 6, 4 pp.
(7) Holland, T. H.
1931. alternative green manure plants. Trop. Agr. [Ceylon] 76 : 135–136.
(8) Keuchenius, A. A. M. N.
1924. botanische kenmerken en cultuurwaarde als groenbemester van een 60-tal nieuwe soorten van leguminosen. [Dutch East Indies] Proefsta. v. Thee Meded. No. 90, 44 pp., illus. (See p. 38.)
(9) Van Helten, W. M.
1924. practische ervaringen met verschillende soorten groenbemesters. [Dutch East Indies] Alg. Proefsta. v. Landb. Meded. No. 16, 72 pp., illus. (See p. 51.)

RECOMMENDED PRACTICES FOR TROPICAL KUDZU

1. Tropical kudzu is a vigorous, deep-rooted, twining legume, which is relatively resistant to drought. In Puerto Rico it is recommended primarily for lowland and upland pasture areas, for controlling erosion, and for ground cover in economic tree plantations. It appears to grow best in regions having not less than 50 inches of rainfall annually.
2. The nutritive value of a forage grass such as Pará grass or molasses grass can be increased by interplanting with tropical kudzu, which is relatively high in protein.
3. The use of tropical kudzu in dairy and beef cattle rations will reduce the need for expensive imported concentrates.
4. Tropical kudzu can be established from seed and with regular rains will cover the ground within 6 months after planting; it is perennial and grows 12 months of the year.
5. It grows somewhat better on the medium to heavy clays, but good ground cover has been obtained on sandy loams.
6. Best time for planting seed in Puerto Rico is at the beginning of the rainy season which is between April and May in most regions; seed are planted in rows or hills 3 to 20 feet apart, depending upon availability of seed and labor, and the rapidity with which a ground cover is desired.
7. Seed should be scarified for better germination, and inoculated with a special nodule-forming bacteria for kudzu.
8. Seedlings grow slowly at first, but this can be speeded up by preparing a fine seedbed 6 to 10 inches deep and fertilizing with manure and/or a complete fertilizer.
9. One or two weedings are necessary to eliminate weed competition with the young seedlings.
10. Since tropical kudzu is a legume, nitrogen applications are not necessary once the crop is established. Phosphorus and potassium may be needed at 1- or 2-year intervals, depending upon the amount of grazing and the fertility of the soil.
11. Tropical kudzu under favorable soil and climatic conditions may produce between 12 to 20 tons of green forage per acre per year and 150 pounds or more of hand-harvested seed.

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